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Stock Status Update of Witch Flounder in NAFO Div. 2J and 3KL

by

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[1]La présente série documente les bases scientifiques des évaluations des ressources halieutiques sur la côte atlantique du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

Les Documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au secrétariat.

Abstract

The witch flounder fishery began in the early 1960's and peaked at a catch of 24,000 t in 1974 after which the annual catch generally declined. By 1994, there was virtually no commercial catch from this stock (12 t). Estimates of trawlable biomass of this stock for the early 1980's averaged about 40,000 t annually before declining to less than 1,000 t by 1994. The remaining resource, although low in abundance, appears to be concentrated in water depths of greater than 1,000 m near the border of Div. 3K and 3L. Commercial fishing for this stock in its present condition is not advised.

Résumé

La pêche de la plie grise a commencé au début des années 1960 et a culminé en 1974 avec des prises de 24 000 tonnes, qui déclinèrent de façon générale par la suite. En 1994, il n'y avait pratiquement plus de prises commerciales dans le stock considéré (12 tonnes). Les estimations de biomasse chalutable dans le stock au début des années 1980 se situaient en moyenne aux alentours de 40 000 t chaque année, avant de chuter à moins de 1 000 t en 1994. La biomasse restante, quoique de faible abondance, semble se concentrer à des profondeurs supérieures à 1 000 mètres près de la limite des divisions 3K et 3L. Vu l'état actuel du stock, la pêche commerciale y est déconseillée.

The Commercial fishery

The commercial fishery began for witch in this area in the early 1960's and increased steadily from about 1,000 t in 1963 to a peak of over 24,000 t in 1973 (Table 1). Catches declined rapidly to 2,800 t by 1980 and subsequently fluctuated between 3,000 and 4,500 t to 1991. The catch in 1992 declined to 2,300 t, the lowest since 1964, and further declined to 342 t in 1993 and just 12 t were reported in 1994 (Table 1). Up until the late 1980's, the fishery was prosecuted by Poland, USSR and Canada (Table 1) primarily in Div. 3K (Table 2; Fig. 1). In recent years the fishery has been mainly Canadian although significant catches were estimated as taken by EU (Portugal) in the NAFO Regulatory area of Div. 3L. For 1994, however, no catch of witch flounder was estimated for the Regulatory Area of Div. 3L.

Since 1988, the offshore Canadian fishery has been particularly successful by fishing on prespawning concentrations in the deep slopes of Div. 3K, especially in depths beyond 700 m. Between 1988 and 1993, however, the area fished has become increasingly smaller and substantially deeper. Based upon information from the fishing industry, the fishery during the winter of 1993 was very poor with the best catch rates occurring in depths greater than 1400 m. As the season progressed, catch rates quickly declined until they became too low for economic viability and the fishery was curtailed. Similar observations were made during the winter of 1994, only more extreme, which caused the catch in 1994 to be virtually nothing.

No new ageing data were available from the previous assessment.

Research vessel data

Stratified-random research vessel surveys have been conducted in the fall in Div. 2J,3K and 3L since 1977, 1978 and 1981 respectively. For Div. 2J, biomass estimates ranged from as high as 4,100 t in 1986 to a low of less than 160 t in 1994 (Table 3; Fig. 2). In Div. 3K, during 1979-85, there was a period of relative stability where most annual biomass estimates were over 30,000 t (Table 4; Fig. 2). Since that time estimates have declined considerably to just over 340 t in 1994, the lowest in the time series. For Div. 3L, biomass estimates varied generally between 6,000 and 7,000 t from 1981 to 1988 but declined rapidly since then to a low of just under 1,500 t in 1992 and less than 400 t by 1993 and 1994 (Table 5; Fig. 2). For the three divisions combined, there has been a very steady and rather systematic decline from about 1984 through 1994 with the estimate of 900 t in 1994, the lowest in the time series.

Estimates of biomass by depth indicate that for all divisions in the earlier years, the biomass is distributed in depths generally less than 500 m (Fig. 3). Since 1989 most witch flounder is found in depths greater than 500 m although the overall biomass in all depths and areas is now extremely low.

No new ageing data were available from the previous assessment.

Prognosis

It is clear that this stock has been reduced to levels far below anything observed in the past. It would seem also that during the 1980's, declining trends in biomass observed in the surveys cannot be fully explained by the removals of the commercial fishery as the commercial catch over trawlable biomass ratios are generally quite low during most of the period (Table 6;

Fig. 4). On the other hand, having observed the shrinking area of distribution in recent years (as presented in the previous assessment) coupled with the fact that fishing was most intense in this area upon prespawning aggregations, it is probable that recent catches may have accelerated the decline over the last few years as suggested by the much increased ratio's in 1991 and 1992. It may be argued that because the fishery has recently been prosecuted well beyond depths occupied by the surveys, biomass estimates may be biased downwards, at least to some degree. Nevertheless, fishing took place in a very restricted area in 1993 and was a failure as indicated by poor catch levels in comparison to the total allowable catch. In 1994, no concentrations could be found by commercial vessels to support a viable fishery, therefore, virtually no fishery was conducted. It is difficult not to accept that this stock is at a dangerously low level and exploitation of this stock in its present state continues to be unjustifiable from a conservation point of view.

Table 1. Catch by country of witch flounder in Div. 2J and 3KL during 1963-94.

Year	Canada	Fed. Rep. Germany	German Dem. Rep.	Poland	USSR/ Russia	UK	Others	Total
1963	17	3	0	259	89	7	570	945
1964	103	0	0	752	164	24	1	1044
1965	128	29	0	1876	2056	58	0	4147
1966	187	9	1045	559	1868	29	0	3697
1967	901	0	332	926	1933	9	0	4101
1968	446	0	358	1990	7834	33	5	10666
1969	1355	0	546	957	9726	1	0	12585
1970	4020	0	508	3566	9934	0	2	18030
1971	8030	75	508	5404	2018	9	9	16053
1972	5520	6	648	4013	7016	225	0	17428
1973	3761	1348	2327	11802	2834	258	2031	24361
1974	1868	1082	272	5302	6917	29	493	15963
1975	1352	446	374	4583	4763	0	687	12205
1976	2081	606	110	3828	3022	3	975	10625
1977	4371	300	203	3052	392	0	0	8318
1978	1979	23	58	3490	1345	1	8	6904
1979	1392	0	22	1855	150	22	656	4097
1980	1459	0	16	1235	45	0	68	2823
1981	2661	0	32	1385	85	0	31	4194
1982	1206	0	4	1151	552	0	68	2981
1983	1483	0	50	1005	516	0	34	3088
1984	2077	0	27	1617	1000	2	85	4808
1985	1305	26	33	565	1006	-	68	3003
1986	1199	2	7	3	21	-	2684	3916
1987	854	-	56	765	1057	-	1743	4475
1988	3270	-	10	760	4	-	110	4154
1989	4059	-	4	691	5	-	147	4906
1990	3271	-	-	-	-	-	696	3967
1991	2805	-	-	-	-	1	1208	4014
1992a	1707	-	-	-	-	-	629	2336
1993a	342	-	-	-	-	-	-	342
1994a	12	-	-	-	-	-	-	12

aProvisional

Table 2 . Nominal catches of witch flounder by division for Div. 2J and 3KL from 1963-94.

Year	Div. 2J	%2J	Div. 3K	%3K	Div. 3L	%3L	Total
1963	38	4.02	263	27.83	644	68.15	945
1964	92	8.81	560	53.64	392	37.55	1044
1965	2547	62.73	1049	25.84	464	11.43	4060
1966	1268	34.3	2000	54.1	429	11.6	3697
1967	1357	33.09	1322	32.24	1422	34.67	4101
1968	1716	16.09	8119	76.12	831	7.79	10666
1969	4852	38.55	6457	51.31	1276	10.14	12585
1970	5604	31.08	9961	55.25	2465	13.67	18030
1971	1978	12.32	8462	52.71	5613	34.97	16053
1972	1443	8.33	11801	68.14	4074	23.52	17318
1973	1048	4.44	17624	74.61	4949	20.95	23621
1974	3497	21.91	10550	66.09	1916	12	15963
1975	1185	9.71	9621	78.83	1399	11.46	12205
1976	683	6.43	7533	70.9	2409	22.67	10625
1977	2267	27.25	5091	61.2	960	11.54	8318
1978	640	9.27	5761	83.44	503	7.29	6904
1979	188	4.59	3027	73.88	882	21.53	4097
1980	41	1.45	2496	88.42	286	10.13	2823
1981	110	2.62	3436	81.93	648	15.45	4194
1982	149	5	2198	73.73	634	21.27	2981
1983	200	6.48	2412	78.11	476	15.41	3088
1984	155	3.22	4000	83.11	658	13.67	4813
1985	160	5.33	1998	66.53	845	28.14	3003
1986	95	2.43	637	16.27	3184	81.31	3916
1987	1100	24.58	1141	25.5	2234	49.92	4475
1988	8	0.19	3189	76.77	957	23.04	4154
1989	5	0.1	3987	81.27	914	18.63	4906
1990	62	1.56	2494	62.87	1411	35.29	3967
1991	215	5.36	2241	55.76	1558	38.87	4014
1992	-	0	1232	52.74	1104	47.26	2336
1993	-	0	207	60.53	135	39.47	342
1994	0	0	8	66.67	4	33.33	12

1992-94 are provisional

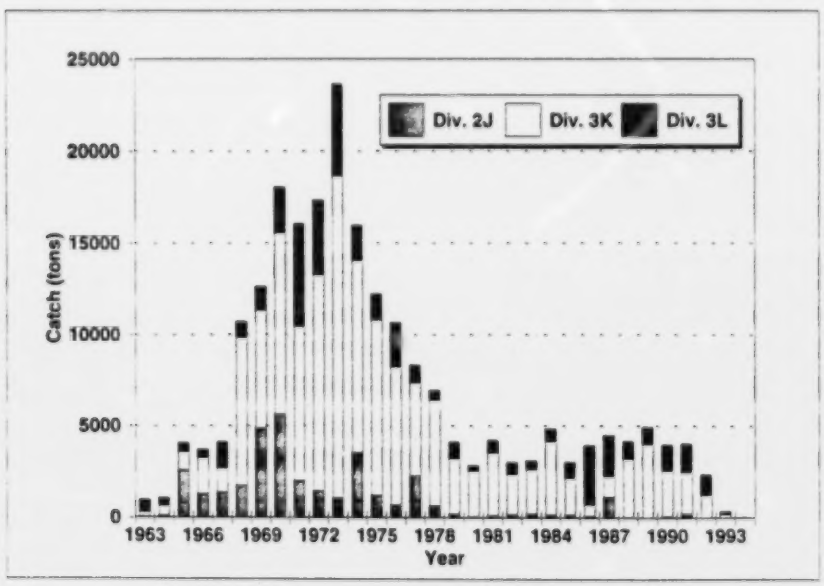


Fig. 1. Nominal catch of witch flounder in NAFO Div. 2J, 3K and 3L from 1963-94 (1992-94 are provisional).

Table 3. Biomass (tons) by stratum of witch flounder from the autumn surveys of the GADUS ATLANTICA in Div. 2J from 1977-92. Based on old stratification system.

Depth Range (m)	Area (sq. nm)	Stratum	Trawlable Units ('000)	Year															
				1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
101-200	1427	201	107	0	0	0	0	0	0	0	43	0	0	0	0	0	0	0	0
	1823	205	137	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
	2582	206	194	83	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0
	2246	207	169	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0	0
201-300	440	202	33	0	0	0	0	0	0	0	0	0	0	0	-	0	0	0	0
	1608	209	121	63	18	35	81	0	54	77	11	100	0	0	0	0	10	0	0
	774	210	58	92	19	102	174	15	99	0	207	0	0	26	0	15	0	0	0
	1725	213	129	192	185	135	215	194	220	120	84	52	79	67	12	35	0	0	0
	1171	214	88	136	34	0	46	44	66	43	33	59	24	0	13	3	9	0	0
	1270	215	95	152	16	7	0	61	37	0	31	0	0	0	0	0	0	0	0
	1428	228	107	368	79	283	354	116	450	169	322	39	533	47	90	81	36	0	26
	508	234	38	0	17	30	0	0	0	0	0	0	0	0	0	-	0	0	0
301-400	480	203	36	0	0	0	0	0	30	87	0	0	11	0	0	12	0	0	0
	448	208	34	116	21	57	261	84	465	50	76	448	37	0	0	6	0	0	0
	330	211	25	304	140	59	216	43	152	5	43	37	22	20	0	20	0	0	0
	384	216	29	0	0	18	18	36	36	67	0	0	29	7	4	9	0	0	0
	441	222	33	160	57	17	58	132	204	44	27	28	0	0	93	25	0	5	0
	567	229	43	114	106	109	106	85	96	75	61	31	553	21	88	312	21	19	13
401-500	354	204	27	42	0	27	-	70	84	9	60	0	41	9	31	36	8	0	0
	268	217	20	0	0	11	0	0	0	0	-	0	33	38	21	43	3	0	0
	180	223	14	9	0	0	0	27	0	0	14	0	92	67	26	51	8	7	2
	686	227	51	140	82	44	348	129	273	167	77	116	204	265	189	135	1038	105	60
	420	235	32	560	0	293	315	363	284	701	352	244	55	79	0	37	76	17	14
501-750	664	212	50	1299	68	655	137	561	970	1110	565	959	2384	769	242	358	363	42	144
	420	218	32	0	0	-	0	0	0	0	-	8	0	55	87	42	29	8	0
	270	224	20	0	0	0	0	0	0	0	0	0	15	30	65	57	8	26	20
	237	230	18	0	0	-	9	0	0	0	13	0	29	9	97	244	440	896	156
751-1000	213	219	16	-	-	-	-	0	-	0	-	0	0	0	0	0	0	0	0
	182	231	14	0	0	-	0	-	0	0	0	0	0	0	0	0	0	278	84
	122	236	9	0	-	-	-	8	0	0	0	0	0	0	4	-	12	13	23
1001-1250	324	220	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	177	225	13	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	236	232	18	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1251-1500	268	221	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	180	226	14	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	180	233	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total	25033			3829	843	1883	2337	1968	3573	2726	2020	2122	4142	1511	1061	1520	2061	1417	542
101-200	8078			83	0	0	0	0	53	0	43	0	0	0	0	0	0	0	0
201-300	8924			1002	369	592	870	429	927	410	689	249	635	141	115	134	55	0	26
301-400	2650			693	325	259	659	381	983	329	207	545	652	48	185	384	21	24	13
401-500	1908			751	82	376	663	589	641	878	503	360	426	458	267	302	1132	129	76
501-750	1591			1299	68	655	146	561	970	1110	578	967	2429	864	490	701	841	972	320
751-1000	517			0	0	0	0	8	0	0	0	0	0	0	4	0	12	292	108
1001-1250	737			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1251-1500	628			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3 (con'd) . Biomass (tons) per stratum of witch flounder from the autumn survey of the GADUS ATLANTICA in Div. 2J during 1993-94. Based on the new stratification system.

Depth Range (m)	Stratum	Area (sq. nm)	Trawlable Units (000)	1993	1994
101-200	201	633	48	0	0
	205	1594	120	0	0
	206	1870	140	0	0
	207	2264	170	0	0
	237	733	55	0	0
	238	778	58	-	0
201-300	202	621	47	0	0
	209	680	51	0	0
	210	1035	78	0	0
	213	1583	119	0	0
	214	1341	101	0	0
	215	1302	98	0	0
	228	2196	165	13	0
	234	530	40	0	0
301-400	203	487	37	0	0
	208	588	44	0	0
	211	251	19	0	0
	216	360	27	0	0
	222	450	34	0	0
	229	536	40	1	9
401-500	204	288	22	0	0
	217	241	18	0	1
	223	158	12	3	2
	227	598	45	66	0
	235	414	31	0	7
	240	133	10	8	4
501-750	212	557	42	23	12
	218	362	27	1	2
	224	228	17	0	7
	230	185	14	37	42
	239	120	9	0	0
					0
751-1000	219	283	21	4	1
	231	186	14	93	55
	236	193	14	23	13
1001-1250	220	303	23	-	-
	225	195	15	-	-
	232	228	17	-	-
					-
1251-1500	221	330	25	-	-
	226	201	15	-	-
	233	237	18	-	-
Biomass (t)				273	157
<=400				14	9
401-750				138	78
>750				120	70
<500				92	24
>500				181	133

Table 4. Biomass estimates (tons) by stratum of witch flounder from autumn surveys of the GADUS ATLANTICA in Div. 3K .

Depth Range(m)	Area (sq. nm)	Stratum	Trawlable units ('000)	Year														
				1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
101-200	1455	618	109	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0
	1588	619	119	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0
201-300	2709	620	203	539	982	364	92	124	112	73	33	124	0	0	0	0	0	0
	2859	621	215	528	2805	519	352	148	708	238	258	15	36	0	28	0	0	0
	668	624	50	205	99	58	263	301	88	245	50	40	12	0	0	5	0	0
	447	632	34	249	447	143	336	268	308	-	157	67	15	18	54	0	2	3
	1618	634	121	497	616	703	357	680	126	638	219	163	103	216	74	0	0	7
	1274	635	96	1290	1491	1140	1033	526	337	1491	525	11	88	207	106	10	0	16
	1455	636	109	1119	1189	1334	819	639	546	2481	529	193	312	601	273	35	0	0
	1132	637	85	859	1680	1077	1445	1475	3001	2131	1802	467	597	177	144	0	0	24
301-400	1027	623	77	281	503	347	417	262	520	254	424	94	89	5	3	0	0	0
	850	625	64	509	1513	739	1077	319	1148	954	930	31	83	45	2	0	0	0
	919	626	69	2036	3642	3822	780	2732	2544	874	729	31	110	10	20	18	0	10
	1085	628	81	1669	4493	2688	882	1812	3814	1559	1765	493	316	21	92	0	0	27
	495	629	37	1102	1062	1538	1573	864	1591	771	646	159	334	98	14	28	0	2
	544	630	41	593	479	654	643	-	500	359	168	98	107	83	11	0	0	6
	2179	633	164	1773	2023	2764	1034	1793	2043	2306	1467	996	649	1179	595	173	79	49
	2059	638	155	2057	5972	2926	4134	2260	3218	6236	4841	6434	4155	5264	2368	199	202	40
	1463	639	110	944	903	1501	1233	829	2933	2819	1345	1217	490	1854	360	359	44	5
401-500	632	622	47	161	782	1198	700	356	640	474	919	130	403	3	2	13	3	10
	1194	627	90	1626	2114	5938	8492	5646	6924	5714	2298	753	886	602	216	73	1	16
	1202	631	90	738	1106	1459	5495	541	4178	4412	2739	1788	973	302	131	34	127	121
	198	640	15	81	-	119	48	342	-	316	718	1289	1616	936	840	112	116	8
	204	645	15	5	-	0	8	250	203	1367	153	-	1968	348	142	504	56	6
501-750	584	641	44	0	0	22	50	55	190	0	745	-	1200	-	-	7701	646	0
	333	646	25	0	0	44	6	15	462	75	59	-	87	-	-	151	81	21
751-1000	931	642	70	0	-	35	0	23	-	93	50	-	39	-	-	1648	730	473
	409	647	31	0	0	0	0	0	-	-	15	-	-	-	-	232	372	89
1001-1250	1266	643	95	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-
	232	648	17	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1251-1500	954	644	72	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-
	263	649	20	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total	34228			18861	33903	31130	31268	22260	36135	35881	23585	14593	14670	11970	5475	11297	2458	935
101-200	3043			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
201-300	12162			5287	9309	5337	4696	4162	5226	7297	3571	1080	1164	1219	678	49	2	50
301-400	10621			10964	20591	16979	11773	10870	18313	16133	12316	9552	6334	8559	3466	778	325	140
401-500	3430			2611	4002	8714	14743	7136	11945	12283	6828	3961	5845	2193	1331	737	303	162
501-750	917			0	0	66	57	70	652	75	804	0	1287	0	0	7853	726	21
751-1000	1340			0	0	35	0	23	0	93	66	0	39	0	0	1880	1102	562
1001-1250	1498			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1251-1500	1217			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4 (con'd). Biomass estimates (tons) by stratum of witch flounder from autumn surveys of the GADUS ATLANTICA in Div. 3K during 1993-94. Based on the new stratification scheme.

Depth Range(m)	Stratum	Area (sq. nm.)	units ('000)	1993	1994
101-200	618	1347	101	0	0
	619	1753	132	0	0
201-300	620	2545	191	0	0
	621	2736	205	0	0
	624	1105	83	7	0
	634	1555	117	2	0
	635	1274	96	0	0
	636	1455	109	0	0
	637	1132	85	8	0
301-400	617	593	45	0	0
	623	494	37	0	0
	625	888	67	0	0
	626	1113	84	0	0
	628	1085	81	0	0
	629	495	37	0	0
	630	332	25	9	0
	633	2067	155	33	23
	638	2059	155	29	2
	639	1463	110	0	16
401-500	622	691	52	4	0
	627	1255	94	5	9
	631	1321	99	11	96
	640	69	5	0	0
	645	216	16	3	1
	650	134	10	12	2
501-750	641	230	17	5	1
	646	325	24	13	23
	651	359	27	17	10
751-1000	642	418	31	32	29
	647	360	27	24	62
	652	516	39	131	71
1001-1250	643	733	55	-	-
	648	228	17	-	-
	653	531	40	288	-
1251-1500	644	474	36	-	-
	649	212	16	-	-
	654	479	36	-	-
Biomass (t)				633	345
<500				123	150
>500				510	195

Table 5. Biomass estimates (tons) by stratum of witch flounder from fall surveys of research vessels in Div. 3L during 1981-94.

Depth Range (m)	Area (sq. nm.)	Stratum	Trawlable Units ('000)	Year													
				1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
57-91	2071	350	155	0	0	0	81	0	0	0	0	0	0	0	0	0	0
	1780	363	134	0	67	0	55	0	27	0	0	0	158	20	32	0	0
	1121	371	84	0	0	0	24	0	0	0	0	0	0	0	0	0	0
	2460	372	185	0	0	0	89	0	0	0	9	0	31	6	0	0	0
	1120	384	84	-	0	84	62	0	0	0	0	0	0	0	0	0	0
93-183	1519	328	114	-	-	-	29	0	0	0	0	0	0	0	0	0	0
	1574	341	118	0	24	0	154	0	0	20	20	0	0	0	0	0	0
	585	342	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	525	343	39	0	-	0	54	0	0	0	0	0	0	0	0	0	0
	2120	348	159	27	95	22	220	0	0	0	24	0	0	0	0	0	0
	2114	349	159	0	0	0	167	0	90	0	17	0	87	0	0	0	0
	2817	364	211	224	97	25	125	0	97	0	23	0	19	0	0	0	0
	1041	365	78	20	98	0	56	0	50	23	11	0	0	27	0	0	0
	1320	370	99	25	0	0	110	0	0	20	0	0	0	0	0	0	0
	2356	385	177	0	0	0	168	0	35	34	16	0	0	0	0	0	0
	1481	390	111	0	0	0	92	0	0	0	0	0	0	0	0	0	0
184-274	1494	344	112	196	0	56	84	7	7	99	0	0	0	0	0	0	0
	983	347	74	209	30	24	295	0	27	0	106	59	0	0	0	0	0
	1394	366	105	175	366	0	107	203	177	115	70	90	28	0	3	0	0
	961	369	72	415	366	126	224	384	416	206	729	289	289	94	0	0	0
	983	386	74	775	129	-	81	322	742	904	1204	192	131	192	0	0	0
	821	389	62	-	270	-	126	74	502	141	116	15	49	0	14	0	0
	282	391	21	-	0	0	0	16	0	5	0	0	0	38	12	0	0
275-366	1432	345	107	2137	2351	3722	2695	764	349	2634	1375	1766	330	0	9	12	0
	865	346	65	3019	1210	1266	817	1338	2118	755	1208	925	1180	105	14	4	0
	334	368	25	13	19	-	38	19	215	11	44	113	53	20	9	0	0
	718	387	54	229	745	-	108	253	135	374	1112	970	2233	86	29	17	2
	361	388	27	-	24	-	772	24	-	332	54	81	0	65	96	0	7
	145	392	11	-	0	11	38	6	11	32	8	0	0	0	0	0	2
367-549	186	729	14	-	-	-	87	157	162	-	-	-	28	170	143	24	68
	216	731	16	-	-	-	247	154	-	-	-	-	319	95	206	19	34
	468	733	35	-	-	-	167	691	-	-	-	-	990	1255	356	104	30
	272	735	20	-	1169	-	197	31	1021	-	-	-	-	114	114	21	6
550-731	170	730	13	-	-	-	57	13	-	-	-	-	-	68	4	83	101
	231	732	17	-	-	-	178	139	-	-	-	-	16	109	393	26	95
	228	734	17	-	-	-	20	103	-	-	-	-	89	47	8	56	24
	175	736	13	-	-	302	-	151	401	-	-	-	197	505	51	29	13
Grand Total	38723			7463	7059	5640	7824	4848	6582	5702	6146	4500	6228	3016	1491	394	382
57-91	8552			0	67	84	311	0	27	0	9	0	189	26	32	0	0
92-183	17452			296	314	48	1174	0	273	96	112	0	106	27	0	0	0
184-274	6918			1769	1161	207	917	1006	1870	1469	2225	645	496	324	29	0	0
275-366	3855			5398	4348	4999	4467	2404	2828	4137	3801	3856	3797	276	156	33	11
367-549	1142			0	1169	0	699	1033	1183	0	0	0	1337	1634	819	168	138
550-731	804			0	0	302	255	405	401	0	0	0	302	729	456	194	233

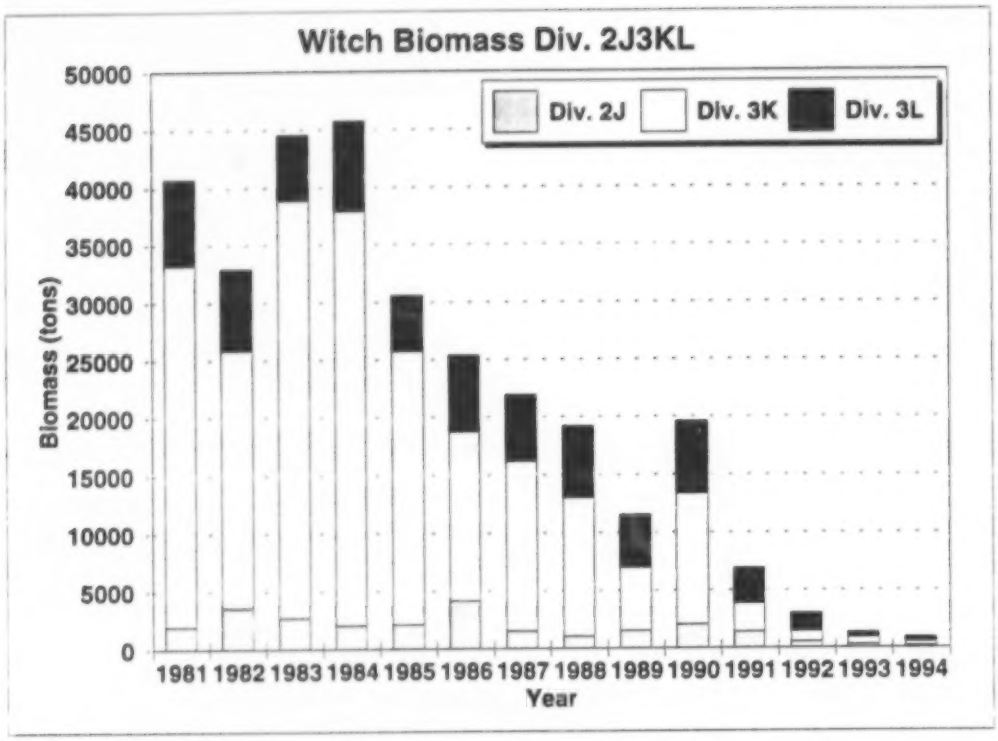


Fig. 2 Biomass estimates of witch flounder in Divisions 2J, 3K and 3L from research vessel surveys during 1981-94(autumn).

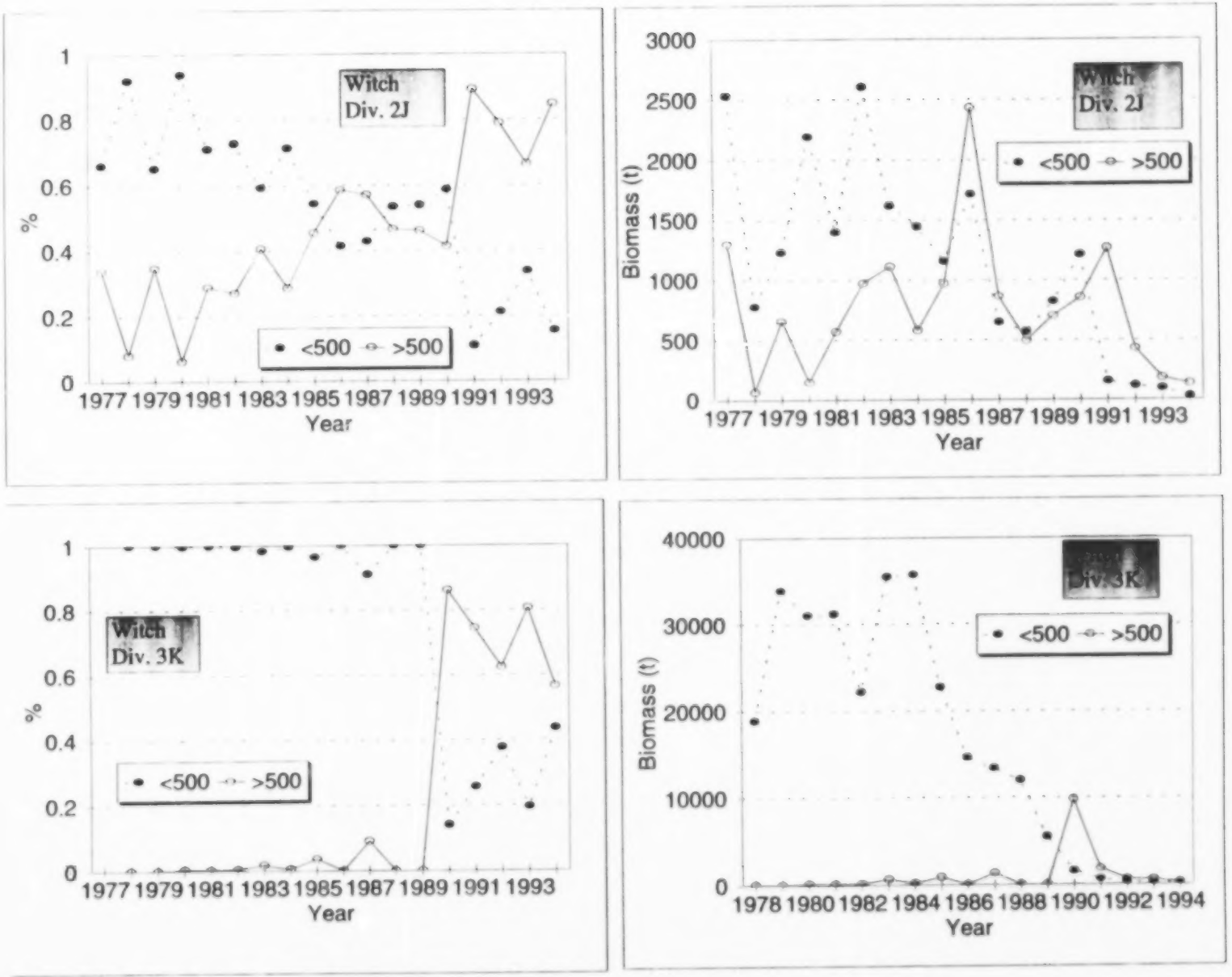
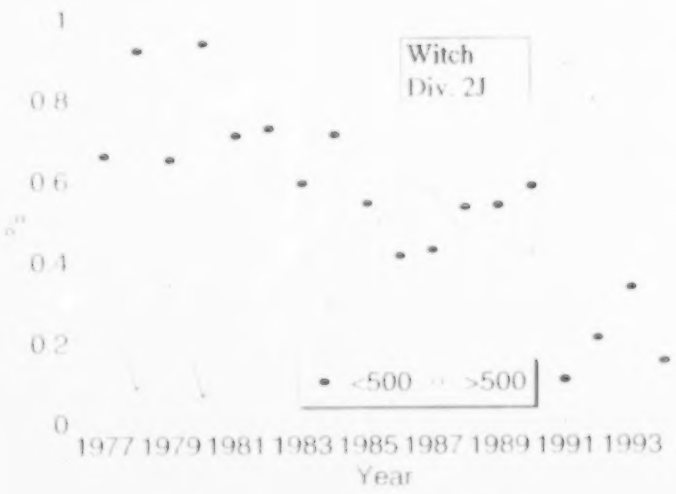
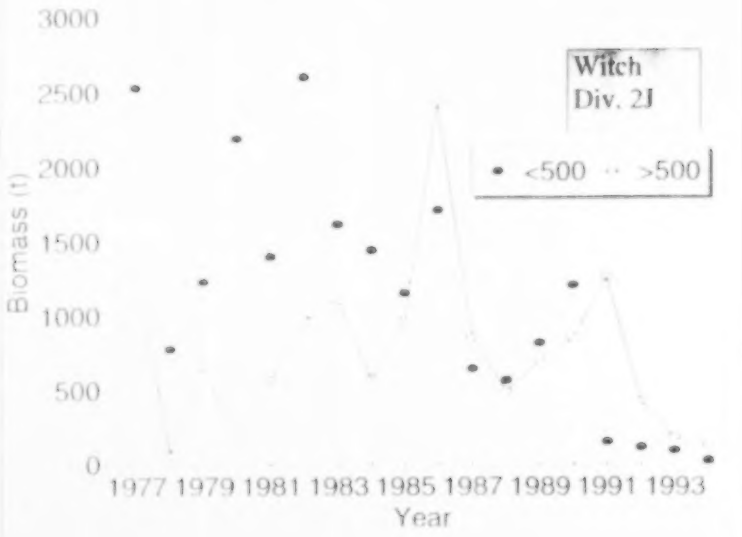
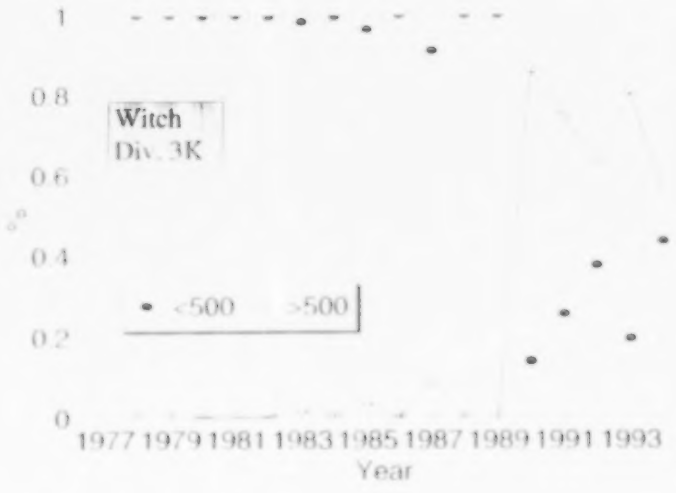


Fig. 3 Depth distribution of survey catches of witch flounder in Div. 2J and 3K during 1977-94.







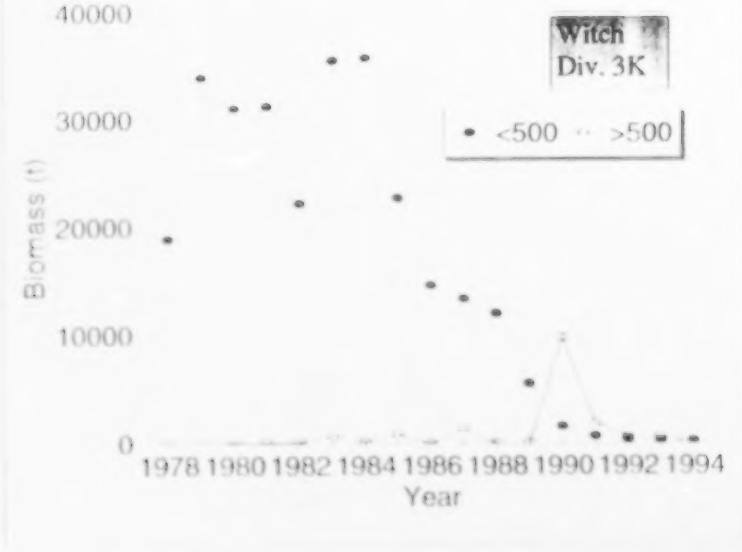


Fig. 3 Depth distribution of survey catches of witch flounder in Div. 2J and 3K during 1977-94

Table 6. Ratio of commercial catch vs. trawable biomass (lagged one year) for witch flounder in Div. 2J and 3KL during 1978-94.

Div. 2J3KL		Biomass				Catch/Biomass
Year	Comm. Catch	Survey 2J	Survey 3K	Survey 3L	Survey Total	Ratio (%)
81	4194	1968	31268	7463	40699	
82	2981	3573	22260	7059	32892	7.32
83	3088	2726	36135	5640	44502	9.39
84	4813	2020	35881	7824	45725	10.82
85	3003	2122	23585	4848	30554	6.57
86	3916	4142	14593	6582	25318	12.82
87	4475	1511	14670	5702	21883	17.68
88	4154	1061	11970	6146	19177	18.98
89	4906	1520	5475	4500	11495	25.58
90	3967	2061	11297	6228	19586	34.51
91	4008	1417	2458	3016	6890	20.46
92	2336	542	935	1491	2968	33.90
93	342	273	633	394	1300	11.52
94	12	157	345	382	884	

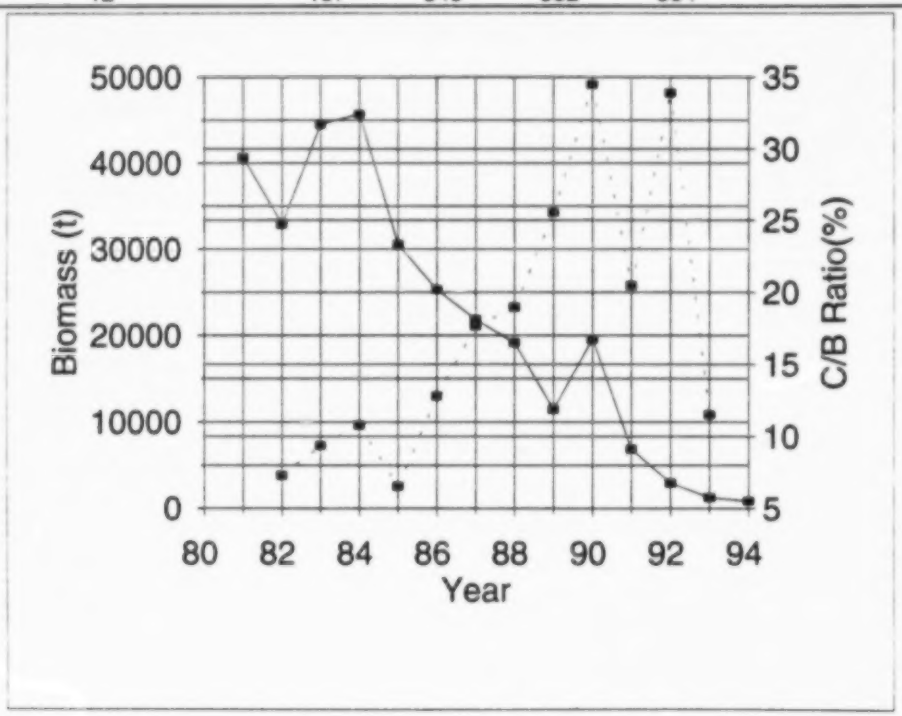


Fig. 4 Ratio of commercial catch and trawlable biomass of witch flounder in Div. 2J and 3KL.